

1. Product Overview

WBR2 is a low-power embedded Wi-Fi and Bluetooth module that Tuya has developed. It consists of a highly integrated RF chip (RTL8720CF) with an embedded Wi-Fi network protocol stack and robust library functions. WBR2 also contains a low-power KM4 microcontroller unit (MCU), a WLAN MAC, a 1T1R capable WLAN baseband, 256 KB static random-access memory (SRAM), 2 MB flash memory, and extensive peripherals.

WBR2 is an RTOS platform that integrates all function libraries of the Wi-Fi MAC and TCP/IP protocols. You can develop embedded Wi-Fi and Bluetooth products as required.

Figure 1-1 shows the WBR2 architecture.

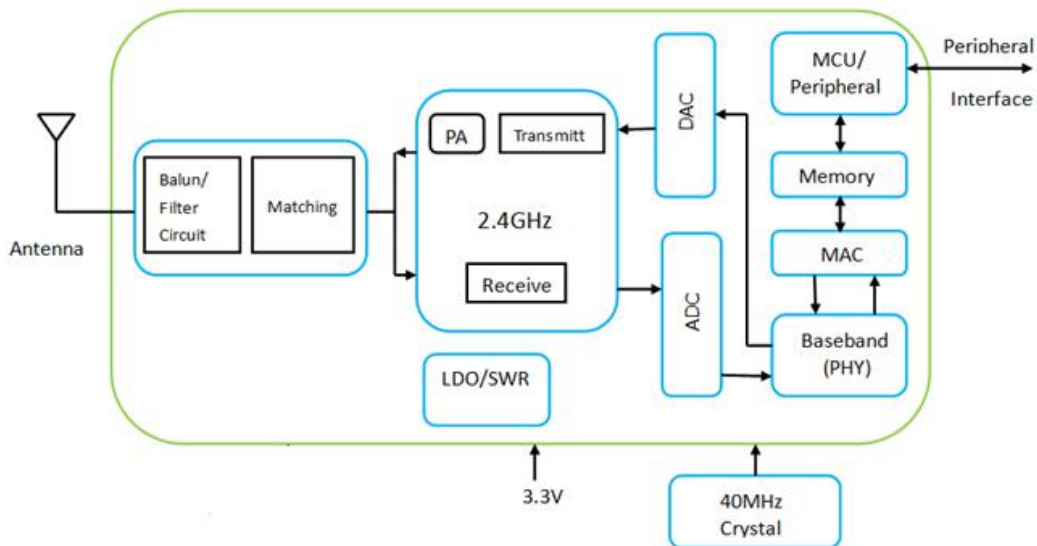


Figure 1-1 WBR2 architecture

1.1 Features

- ✧ Embedded low-power KM4 MCU, which can also function as an application processor
 - Clock rate: 100 MHz
- ✧ Working voltage: 3.0 V to 3.6 V
- ✧ Peripherals: six GPIOs and one universal asynchronous receiver/transmitter (UART)
- ✧ Wi-Fi connectivity
 - 802.11b/g/n20
 - Channels 1 to 14 at 2.4 GHz
 - Compatible with Bluetooth low energy (BLE) 4.2(Up to +9dBm EIRP output power)
 - WPA and WPA2 security modes
 - Up to +20 dBm EIRP output power in 802.11b mode
 - EZ net pairing mode for Android and iOS devices
 - Onboard PCB antenna
 - Certified by CE, FCC, and SRRC
 - Working temperature: -20°C to +85°C

1.2 Application Scenarios

- ✧ Intelligent building
- ✧ Smart household and home appliances
- ✧ Smart socket and light
- ✧ Industrial wireless control
- ✧ Baby monitor
- ✧ Network camera
- ✧ Intelligent bus

Change History

| No. | Date | Change Description | Version After Change |
|-----|------------|----------------------------|----------------------|
| 1 | 2019-10-28 | This is the first release. | 2.0.0 |

Contents

| | | |
|---|--|----|
| 1. Product Overview..... | | 1 |
| 1.1 Features..... | | 2 |
| 1.2 Application Scenarios..... | | 2 |
| 2. Module Interfaces..... | | 6 |
| 2.1 Dimensions and Footprint..... | | 6 |
| 2.2 Interface Pin Definition..... | | 6 |
| 3. Electrical Parameters..... | | 7 |
| 3.1 Absolute Electrical Parameters..... | | 7 |
| 3.2 Working Conditions..... | | 8 |
| 3.3 RF Current Consumption..... | | 8 |
| 3.4 Working Current..... | | 9 |
| 4. RF Features..... | | 10 |
| 4.1 Basic RF Features..... | | 10 |
| 4.2 TX Performance..... | | 10 |
| 4.3 RX Performance..... | | 11 |
| 5. Antenna Information..... | | 11 |
| 5.1 Antenna Type..... | | 11 |
| 5.2 Antenna Interference Reduction..... | | 11 |
| 6. Packaging Information and Production Instructions..... | | 11 |
| 6.1 Mechanical Dimensions..... | | 11 |
| 6.2 Recommended PCB Layout..... | | 12 |
| 6.3 Production Instructions..... | | 13 |
| 6.4 Recommended Oven Temperature Curve and Soldering Temperature..... | | 14 |
| 6.5 Storage Conditions..... | | 16 |
| 7. MOQ and Packing Information..... | | 18 |
| 8. Appendix: Statement..... | | 19 |

Tables

| | |
|---|----|
| Table 2-1 WBR2 interface pins..... | 6 |
| Table 3-1 Absolute electrical parameters..... | 7 |
| Table 3-2 Normal working conditions..... | 8 |
| Table 3-3 Current consumption during constant transmission..... | 8 |
| Table 3-4 Current consumption during constant receiving..... | 9 |
| Table 3-5 Working current..... | 9 |
| Table 4-1 Basic RF features..... | 10 |
| Table 4-2 Performance during constant transmission..... | 10 |
| Table 4-3 RX sensitivity..... | 11 |
| Table 6-1 Recommended wave soldering temperature..... | 15 |

Figures

| | |
|---|----|
| Figure 1-1 WBR2 architecture..... | 1 |
| Figure 2-1 WBR2 front and rear views..... | 6 |
| Figure 6-1 WBR2 mechanical dimensions..... | 12 |
| Figure 6-2 WBR2 pins..... | 12 |
| Figure 6-3 Top and bottom views of the PCB to which WBR2 applies..... | 13 |
| Figure 6-4 Oven temperature curve..... | 15 |
| Figure 6-5 HIC for WBR2..... | 16 |

2. Module Interfaces

2.1 Dimensions and Footprint

WBR2 has two rows of pins with a 2 mm pin spacing.

The WBR2 dimensions (H x W x D) are 2.9 ± 0.15 mm x 15 ± 0.35 mm x 18 ± 0.35 mm. Figure 2-1 shows the WBR2 front and rear views.

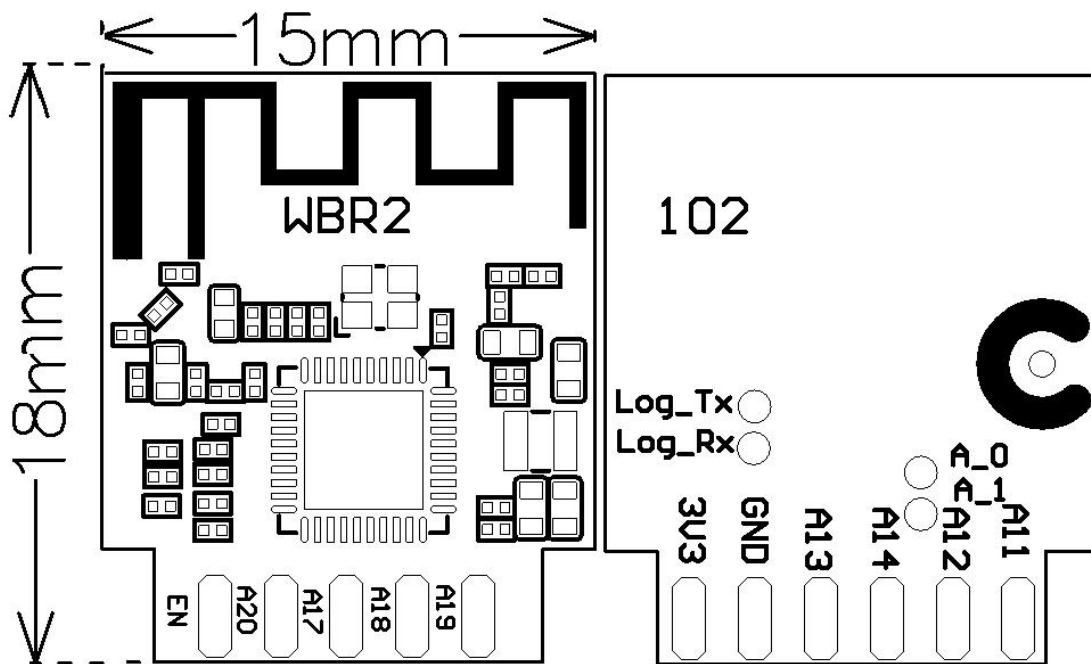


Figure 2-1 WBR2 front and rear views

2.2 Interface Pin Definition

Table 2-1 WBR2 interface pins

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|---|
| 1 | 3V3 | N/A | Power supply pin (3.3 V) |
| 2 | A19 | I/O | GPIOA_19, hardware PWM pin, which is connected to pin 40 on the internal IC |

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|--|
| 3 | GND | P | Power supply reference ground pin |
| 4 | A18 | I/O | GPIOA_18, hardware PWM pin, which is connected to pin 39 on the internal IC |
| 5 | A13 | I/O | GPIOA_13, user-side serial interface pin (UART0_RXD) |
| 6 | A17 | I/O | GPIOA_17, hardware PWM pin, which is connected to pin 38 on the internal IC |
| 7 | A14 | I/O | GPIOA_14, user-side serial interface pin (UART0_TXD) |
| 8 | A20 | I/O | GPIOA_20, common GPIO, which is connected to pin 1 on the internal IC |
| 9 | A12 | I/O | GPIOA_12, hardware PWM pin, which is connected to pin 26 on the internal IC |
| 10 | EN | I/O | Enable pin, which is active at a high level (The pin has been pulled up and is externally controllable.) |
| 11 | A11 | I/O | GPIOA_11, hardware PWM pin, which is connected to pin 25 on the internal IC |

Note:

P indicates a power supply pin, and **I/O** indicates an input/output pin.

3. Electrical Parameters

3.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

| Parameter | Description | Minimum Value | Maximum Value | Unit |
|-----------|----------------------|---------------|---------------|------|
| Ts | Storage temperature | -40 | 105 | °C |
| VDD | Power supply voltage | -0.3 | 3.6 | V |

| Parameter | Description | Minimum Value | Maximum Value | Unit |
|---|-------------|---------------|---------------|------|
| Static electricity voltage (human body model) | Tamb = 25°C | N/A | 2 | kV |
| Static electricity voltage (machine model) | Tamb = 25°C | N/A | 0.5 | kV |

3.2 Working Conditions

Table 3-2 Normal working conditions

| Parameter | Description | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------|-----------------------|---------------|---------------|---------------|------|
| Ta | Working temperature | -20 | N/A | 85 | °C |
| VDD | Working voltage | 3.0 | N/A | 3.6 | V |
| V _{IL} | I/O low-level input | N/A | N/A | 0.8 | V |
| V _{IH} | I/O high-level input | 2.0 | N/A | N/A | V |
| V _{OL} | I/O low-level output | N/A | N/A | 0.4 | V |
| V _{OH} | I/O high-level output | 2.4 | N/A | N/A | V |
| I _{max} | I/O drive current | N/A | N/A | 16 | mA |
| C _{pad} | Input pin capacitance | N/A | 2 | N/A | pF |

3.3 RF Current Consumption

Table 3-3 Current consumption during constant transmission

| Symbol | Mode | Power | Typical Value | Peak Value | Unit |
|-----------------|-----------|--------|---------------|------------|------|
| I _{RF} | 802.11b | 17 dBm | 217 | 268 | mA |
| I _{RF} | 11 Mbit/s | 18 dBm | 231 | 283 | mA |
| I _{RF} | 802.11g | 15 dBm | 159 | 188 | mA |

| Symbol | Mode | Power | Typical Value | Peak Value | Unit |
|--------|--------------|----------|---------------|------------|------|
| IRF | 54 Mbit/s | 17.5 dBm | 177 | 213 | mA |
| IRF | 802.11n BW20 | 13 dBm | 145 | 167 | mA |
| IRF | MCS7 | 16.5 dBm | 165 | 193 | mA |

Table 3-4 Current consumption during constant receiving

| Symbol | Mode | Typical Value | Peak Value | Unit |
|--------|----------------------|---------------|------------|------|
| IRF | 802.11b 11 Mbit/s | 63 | 65 | mA |
| IRF | 802.11g 54 Mbit/s | 65 | 67 | mA |
| IRF | 802.11n HT20 MCS7 | 65 | 67 | mA |

3.4 Working Current

Table 3-5 Working current

| Working Mode | Working Status (Ta = 25°C) | Typical Value | Peak Value | Unit |
|-------------------------|---|---------------|------------|------|
| EZ | The module is in EZ mode, and the Wi-Fi indicator blinks quickly. | 75 | 324 | mA |
| Connected and idle | The module is connected to the network, and the Wi-Fi indicator is steady on. | 64 | 314 | mA |
| Connected and operating | The module is connected to the network, and the Wi-Fi indicator is steady on. | 66 | 305 | mA |
| Disconnected | The module is disconnected from the network, and the Wi-Fi indicator is steady off. | 66 | 309 | mA |

4. RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

| Parameter | Description |
|------------------------|--|
| Frequency range | Bluetooth:2.400 GHz to 2.4835 GHz Wi-Fi:2.412 GHz to 2.484 GHz |
| Wi-Fi standard | IEEE 802.11b/g/n (channels 1 to 14,Ch1-11 for US/CA,Ch1-13 for EU/CN) |
| Data transmission rate | 802.11b: 1, 2, 5.5, or 11 (Mbit/s) 802.11g: 6, 9, 12, 18, 24, 36, 48, or 54 (Mbit/s) 802.11n: HT20 MCS0 to MCS7; |
| Antenna type | PCB antenna |

4.2 TX Performance

Table 4-2 Performance during constant transmission

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|---|-----------|---------------|---------------|---------------|------|
| Average RF output power, 802.11b CCK mode | 1 Mbit/s | N/A | 17.5 | N/A | dBm |
| Average RF output power, 802.11g OFDM mode | 54 Mbit/s | N/A | 14.5 | N/A | dBm |
| Average RF output power, 802.11n OFDM mode | MCS7 | N/A | 13.5 | N/A | dBm |
| Frequency error | | -20 | N/A | +20 | ppm |
| EVM under 802.11b CCK, 11 Mbit/s, 17.5 dBm | | | | -10 | dB |
| EVM under 802.11g OFDM, 54 Mbit/s, 14.5 dBm | | | | -29 | dB |
| EVM under 802.11n OFDM, MCS7, 13.5 dBm | | | | -30 | dB |

4.3 RX Performance

Table 4-3 RX sensitivity

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------------------|-----------|---------------|---------------|---------------|------|
| PER < 8%, 802.11b CCK mode | 1 Mbit/s | N/A | -91 | N/A | dBm |
| PER < 10%, 802.11g OFDM mode | 54 Mbit/s | N/A | -75 | N/A | dBm |
| PER < 10%, 802.11n OFDM mode | MCS7 | N/A | -72 | N/A | dBm |

5. Antenna Information

5.1 Antenna Type

WBR2 uses an onboard PCB antenna with a gain of 2.5 dBi.

5.2 Antenna Interference Reduction

To ensure optimal Wi-Fi performance when the Wi-Fi and Bluetooth module uses an onboard PCB antenna, it is recommended that the antenna be at least 15 mm away from other metal parts.

6. Packaging Information and Production Instructions

6.1 Mechanical Dimensions

The PCB dimensions (H x W x D) are 0.8±0.1 mm x 15±0.35 mm x 18±0.35 mm, as shown in Figure 6-1.

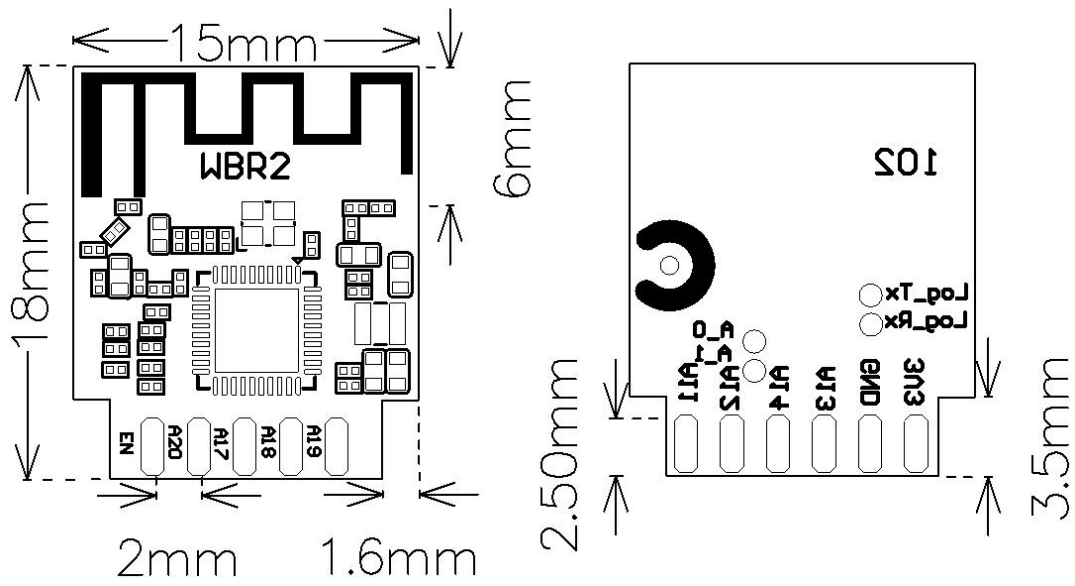


Figure 6-1 WBR2 mechanical dimensions

6.2 Recommended PCB Layout

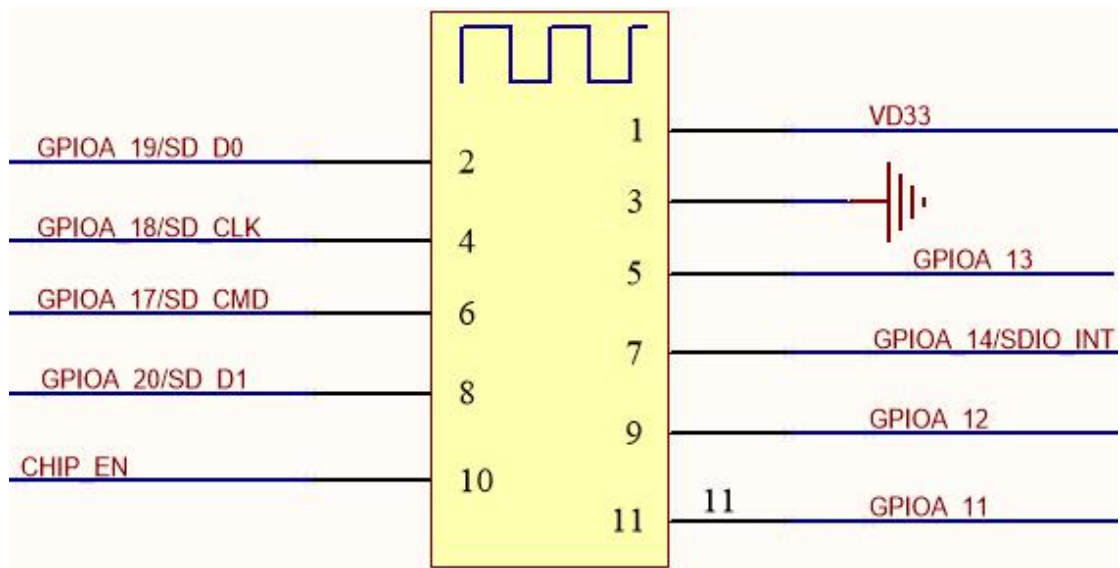


Figure 6-2 WBR2 pins

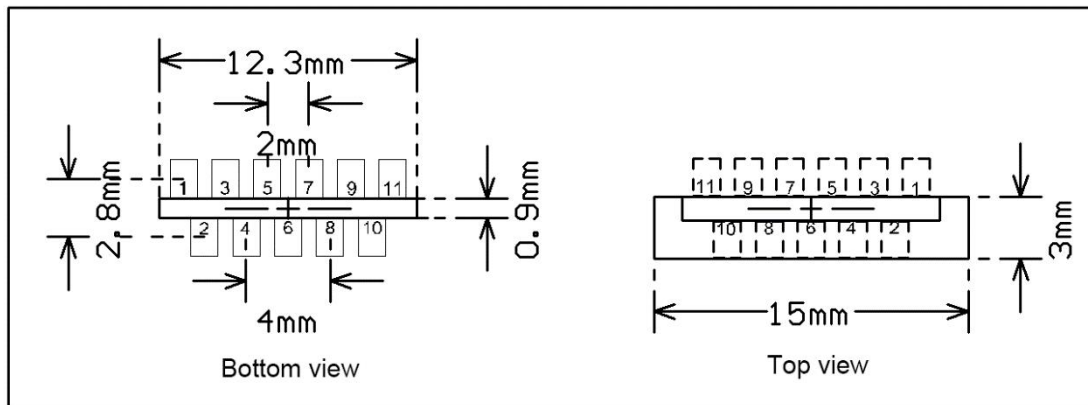


Figure 6-3 Top and bottom views of the PCB to which WBR2 applies

6.3 Production Instructions

1. Preferentially use the wave soldering machine to solder the module, which is recommended for Tuya-developed modules that are through-hole mounted onto PCBs. Use hand soldering only when there is no operational wave soldering machine. Complete soldering within 24 hours after the module is unpacked. If not, vacuum pack the module again.
 - (1) Required materials for soldering:
 - i. Wave soldering machine
 - ii. Wave soldering fixture
 - iii. Constant-temperature iron
 - iv. Wave solder bar, wire, and flux
 - v. Oven temperature tester
 - (2) Baking equipment:
 - i. Cabinet oven
 - ii. Anti-static heat-resistant trays
 - iii. Anti-static heat-resistant gloves
2. Bake the module if any of the following conditions is met:
 - (1) The vacuum package is damaged before the module is unpacked.
 - (2) The package does not contain a humidity indicator card (HIC).

- (3) After the module is unpacked, the HIC shows that the 30% and higher rate circles are pink.
 - (4) Production is not completed within 72 hours after the module is unpacked.
 - (5) The module has been packed for more than six months.
3. Baking settings:
- (1) Baking temperature: $65\pm 5^{\circ}\text{C}$ in reel pack mode and $125\pm 5^{\circ}\text{C}$ in tray pack mode
 - (2) Baking time: 48 hours in reel pack mode and 12 hours in tray pack mode
 - (3) Alarm temperature: 70°C in reel pack mode and 130°C in tray pack mode
 - (4) Production ready temperature after natural cooling: $< 36^{\circ}\text{C}$
 - (5) Number of baking times: 1
 - (6) Rebaking condition: Production is not completed within 72 hours after baking.
4. Do not wave solder modules that have been unpacked for over three months. Electroless nickel immersion gold (ENIG) is used for the PCBs. If the solder pads are exposed to the air for over three months, they will be oxidized severely and dry joints or solder skips may occur. Tuya is not liable for such problems and consequences.
5. Throughout the production process, take electrostatic discharge (ESD) protective measures.
6. For a good product quality, ensure that the following items meet requirements:
- (1) Flux amount
 - (2) Wave height
 - (3) Amount of tin dross and copper in the solder pot
 - (4) Wave soldering fixture window and thickness
 - (5) Oven temperature curve for wave soldering

6.4 Recommended Oven Temperature Curve and Soldering

Temperature

Set the oven temperature to a value recommended for wave soldering. The peak temperature is $260\pm 5^{\circ}\text{C}$. Figure 6-4 shows the oven temperature curve for wave soldering.

DIP Type Product Pass Wavesolder Graph

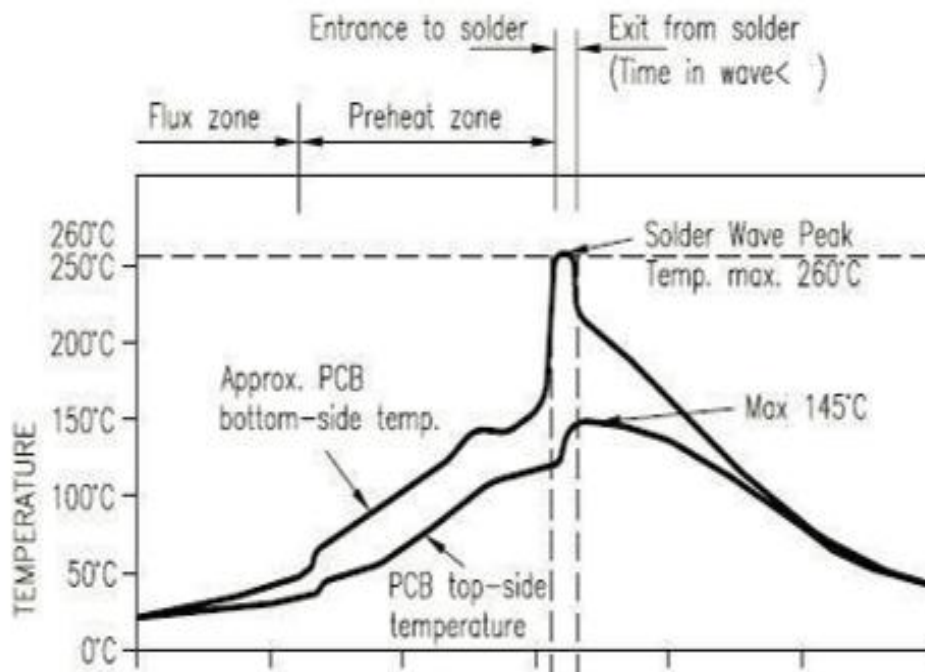


Figure 6-4 Oven temperature curve

Table 6-1 Recommended wave soldering temperature

| Wave Soldering | | Hand Soldering | |
|---------------------------|------------------|----------------------------|----------------|
| Preheat temperature | 80°C to 130°C | Wave soldering temperature | 360±20°C |
| Preheat time | 75s to 100s | Soldering time | < 3s per point |
| Contact time | 3s to 5s | N/A | N/A |
| Solder pot temperature | 260±5°C | N/A | N/A |
| Temperature increase rate | ≤ 2°C per second | N/A | N/A |
| Temperature drop rate | ≤ 6°C per second | N/A | N/A |

6.5 Storage Conditions

Storage conditions for a delivered module are as follows:

1. The moisture-proof bag is placed in an environment where the temperature is below 30°C and the relative humidity is lower than 70%.
2. The shelf life of a dry-packaged product is six months from the date when the product is packaged and sealed.
3. The package contains a HIC.



Figure 6-5 HIC for WBR2

| | | |
|--|--|---|
|  | <p>CAUTION This bag contains MOISTURE-SENSITIVE DEVICES</p> | <p>LEVEL 3</p> |
| <p><i>If Blank, see adjacent bar code label</i></p> | | |
| <p>1. Calculated shelf life in sealed bag: 12 months at < 40°C and < 90% relative humidity (RH)</p> | | |
| <p>2. Peak package body temperature: <u>260</u> °C <small><i>If Blank, see adjacent bar code label</i></small></p> | | |
| <p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p> | | |
| <p>a) Mounted within: <u>168</u> hrs. of factory conditions <small><i>If Blank, see adjacent bar code label</i></small> ≤ 30°C/60%RH, OR</p> | | |
| <p>b) Stored at <10% RH</p> | | |
| <p>4. Devices require bake, before mounting, if:</p> | | |
| <p>a) Humidity Indicator Card is > 10% when read at 23 ± 5°C</p> | | |
| <p>b) 3a or 3b not met.</p> | | |
| <p>5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C</p> | | |
| <p>Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure</p> | | |
| <p>Bag Seal Date: _____ <small><i>If Blank, see adjacent bar code label</i></small></p> | | |
| <p>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</p> | | |

7. MOQ and Packing Information

8. Appendix: Statement

Federal Communications Commission (FCC) Declaration of Conformity

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled rolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Important Note

This radio module must not be installed to co-locate and operating simultaneously with other radios in host system except in accordance with FCC multi-transmitter product procedures. Additional testing and equipment authorization may be required to operating simultaneously with other radio.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination. The firmware setting is not accessible by the end user.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

The end user manual shall include all required regulatory information/warning as shown in this manual, including: This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

This device have got a FCC ID: 2ANDL-WBR2.The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID:2ANDL-WBR2"

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Declaration of Conformity European notice



Hereby, Hangzhou Tuya Information Technology Co., Ltd declares that this module product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU,2011/65/EU.A copy of the Declaration of conformity can be found at <https://www.tuya.com>



This product must not be disposed of as normal household waste, in accordance with EU directive for waste electrical and electronic equipment (WEEE- 2012/19/EU). Instead , it should be disposed of by returning it to the point of sale, or to a municipal recycling collection point.